

## How does life interact with its environment?

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Environments set the stage on which organisms act and evolve. Organisms alter the setting in which they appear. This interplay between life and its environment underlies a series of questions at the heart of astrobiology. Under what conditions do organisms survive—and thrive? How do they alter the world around them, on the scale of a microscopic mineral or an entire planet, over intervals of seconds to billions of years? How do they co-evolve with their environment over geologic time? Our answers to these questions inform our understanding of the world we inhabit and guide our searches for life and habitability on other worlds.

Members of the NAI are addressing these questions from many directions. Some are using geochemical signatures, such as ratios of sulfur isotopes and iron isotopes, in ancient rocks to document the oxidation history of Earth's surface. Others are applying “molecular clocks” to infer the timing of significant evolutionary events and to assess the history of interaction between organisms, microbial processes and Earth's surface environment. Still others are manipulating microbial cultures to understand adaptations for specific biochemical processes or undertaking field experiments to document local environmental consequences of specific biological processes. Several teams are examining the functional diversity, phylogenetic composition and metabolic interactions of extant communities in challenging environments, including hydrothermal springs, subseafloor sediments, deep mines, permafrost and seafloor vent systems. These communities and environments are models for life and habitats in earlier intervals of Earth history. They are also models for life and habitats on other worlds.